Notebook Series -- Notebooks by Experimenters Other Than Edison
Battery Experiments -- M. R. Hutchison Books
Notebook, N-11-04-14

This notebook was used by Miller Reese Hutchison during March-May 1911 for experimental notes on battery cells for submarines, along with other cell tests. Included are entries on "explosion experiments" to determine how to prevent the explosion of gases from the cells. Also included are experiments with the oxidation of nickel to ascertain the best method of rendering the grids of Edison cells dielectric. One entry contains a list of suggestions from Edison regarding the preparation of dielectric nickel. There are also notations by Hutchison concerning Edison's comments and suggestions about his work. The front cover is labeled "Experiment Submarine Cells M R Hutchison Edison Laboratory" and "501." An index appears on the flyleaf. The book contains 150 numbered pages, many of which are blank, followed by approximately 30 unnumbered pages. At least one page has been removed from the book.

N-11-04-14

Rome Co.,

MFG. STATIONERS,

69 FULTON STREET,

NEW YORK.

45009

60/578
8-50
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60/578

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8-0
1 6 7
2 1 5
3 3 1 7
6

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11-04-14

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N

EXPLOSION EXPERIMENTS

RECAPITULATION OF PREVIOUS TESTS &c.

No 1.

Previous to March 6th 1911, two Type E. Edison Cells were properly sealed and then coupled together by pipe with a 3" dia. x 2" long cylinder included in the line. Into this cylinder various thicknesses of fine gauze were placed, properly strengthened by heavier wire screens.

Both cells were in good condition and when completed a photograph was taken.

On March 6th/11 I started in to determine the efficacy of gauze to prevent explosion of gases within one cell from reaching and igniting gases in cell connected by pipe therein.

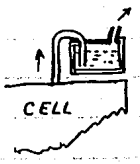
The gauze was found to be of no service.

No 2. I then designed and had constructed a cylinder having inlet pipe from cell passing through top and to within a short distance of the bottom of cylinder. The outlet pipe from cylinder led from the top. The object being to pass the gases formed in the cell,

through the water in the cylinder, thereby

a- reclaiming the KOH carried off by the gas bubbles

b- cooling flame of explosion by passing through the water in cylinder.



The result, as found March 10th 8 P.M. to 4 A.M. March 11th/11, was quite satisfactory.

When the cell was first exploded, some water was blown out of cylinder outer as it was too full. This was remedied and it developed that the vacuum formed by the combination of H_2 and O with water "bucked" the water in cylinder into the cell.

This series of tests warranted design and construction of large separator for the 5-17 size can being made up for similar experiments.

No 3. The method of igniting the charge was first an ordinary spark plug operated by coil and battery. But after each explosion it became necessary to remove plug and

clean the KOH solution off, which short circuited the plug.

No 4- I then procured a "Magnetic plug" from the Bosch Co and substituted for the spark plug. This proved more satisfactory but not perfectly so, as it too became shorted by the KOH

No 5. Then a piece of platinum wire was fastened to a pair of wires leading in through a stopper and connected across the terminals of the cell. The cell was sealed and the wire kept hot enough to explode the gases as formed. But sometimes it failed to work and caused the can to become bulged considerably. I made note to try this on a more practical output later.

Further work on the small E cells was then abandoned, as I am more interested in determining re. large cells. So I ordered made up a large can as per following description.

CAN:

Material of can, 7 point Carbon Steel, cold rolled, " stock.

Dimentions: (INSIDE) -

Height , Width, Thickness

Cubic Contents:

Construction: The metal was bent to form the sides and welded as in A cell practice.

The bottom of " stock was welded in likewise.

On top a 1/4" steel flange was welded on and provided with " bolt holes ( ) tapped.

ELEMENTS:

Material: 1/8" sheet iron, with substantial poles attached and leading through insulation bushings in cover.

Separated " by insulated spacing

Placed so tops would be " from cover.

SEPARATOR:

The separator was made up from " iron pipe with a cap on each end.

Inside Dimentions: Diam - Height.

A 2" Pipe (iron) leads in through the top near side, and to within " from bottom. This screws into an elbow which is attached to another elbow leading from a 2" valve, connected to top of can by 2" pipe.

A 2" pipe of short length forms the outlet from Separator and is screwed into the top of it.

Volume: c.c. filled to top.

c.c. when bottom of leading in tube is uncovered.

Drain - In the bottom of the separator is a small drain cock.

APPURTENANCES: The top of the can is drilled and tapped to take the following:

a: Separator tube – 2".
b: Magnette plug.
c: Spark plug or "platinum" plug
d: Four baskets to hold spongy platinum for igniting.
e: $1\frac{1}{4}$" pipe hole for attaching dial to measure extent of explosion. Plugged up now.
f: Depth gauge pipe closed at bottom end and with slit on side to let liquid into it. Top has cap so by inserting tube or scale, extent of space above liquid can be determined.

Around each of "b", "c", "d" there are gauze baskets attaching to the cover, the object being to prevent liquid from being splashed on the apparatus so readily.

A 4400 watt 6 volt dynamo was installed by my laboratory in S.P.B.Co. plant, and belted to a 15 HP motor so that on April 14th I was ready to start in on the tests.

I assembled the outfit and after filling the can with KOH 21%, I placed the whole in a large crock, so as to catch KOH in case the jar becomes ruptured.

Experiments #6, 7, 8, 9 & 10 are not as complete in detail as I would like, but were intended as preliminary tests only.

No 7. The space above electrolyte was about 6", and the separator had about 4500 c.c. of H_2O in it. There 1000(?) amperes into cell and gassing started violently and at once.

April 14th/11

Ignited with magnette plug. Violent explosion. No flame came out of separator but some water did. (For full)

Cell jumped into air about $1\frac{1}{2}$". Can not bulged at all.

No 8: Refilled separator with about 3750 cc.
Cleaning magnetic pieces. Was very wet with KOH
Let cell gas about 1 min and then exploded it.
Apr 14/11. About as violent as before. Can jumped up about 1½"
No flame or water came out of separator outlet.
Can not bulged at all.

No 9. Syphoned electrolyte out of can until bottom of depth tube showed. This is equivalent to " space.
Put 4250 c.c. of KOH in separator after draining it
Apr 14/11. Violent explosion as before.
Can not bulged at top but a little toward bottom of can.
Temporarily secured can by pcs of 2x4 to keep it from falling over.
3580 c.c. of KOH was sucked into cell from the separator

No 10: Put 4250 c.c. into separator after draining.
Syphoned out can to bottom of tube.
Exploded violently.
Blew water into roof and scattered over place. About a half pint blown out.
Apr 14/11. Can seems to be bulging near bottom and sides but to be concave from about 8" from bottom of can to "armor belt"

No. 11 Drained separator and put in 3500 c.c.
Syphoned out can as before.
Heavy explosion.
No water or fire came out
So 3500 c.c. to about right in separator (3)
Apr 14/11. When investigating can, found a leak in right side. So let it drain out and go into something else.

No. 12. Better can assembled after welding and put KOH in. 4½" space, 4½" depth of solution in separator
Apr. 15/11. Noticed a very marked bulge near bottom and sides

Bulging inward about 1/2" in on right side and 1/16 on left.
Such a heavy explosion.
Considerable water blown out.
900 c.c. left in separator (1 3/8")

Apr. 15/11.

No. 13 Put in all 1500 cc in separator after draining.
3 1/8" space.
Loud report, no jumping of can
No fire. No water.

No. 14 Drained separator and put in 1500 c.c. KOH.
Only 2 1/2" space now
(800 c.c left in separator (1 1/2")) Very loud expl.
Explosion much less violent.
Can concave right 11/16" Left 9/16"

Apr. 15/11.

No. 15 - Drained separator. There was 1200 c.c. left in it, only 600 c.c. having been taken over.
Put this 1200 cc. back in sep.
Smaller explosion than before.
No fire. No water.
Can didn't jump.

Apr. 15/11.

No. 16: Drained separator. 1100 cc in.
2 3/16" space in can.
Right side 21/32, Left 19/32 concave.
Can bulged a little near bottom on sides.
Closed vent valve, thereby sealing can up.
Closed the 1000 amp. circuit and immediately - 5 sec after closed ignition circuit, and kept it closed.
a - First, a small explosion
b - Then a heavy one.
c - Then a small one.
d. Then turned off current on 1000 amp circuit and waited about 10 sec. Closed ignition switch. Slow to answer but when it did, got a very heavy explosion that blew a hole in right side, just above bottom weld. Can bulged out a good deal at sides near bottom.
Electrolyte commenced to run into catching tank and I left it in the night.

Apr. 15/11.

No. 17 – Investigation disclosed break in the seam of weld as result of violent explosion of Exp. 16,
This was welded up and the cell re-assembled.
The electrolyte was diluted to sg 1020 in putting back.
This caused less current to flow from dynamo and does not necessitate shutting down between explosions to let terminals on cell cool off.
But the gas came fast enough to get a good explosion every 30 seconds.
Tried to use platinum sheet set into spark plug but burn after filing down to about $\frac{3}{64}$" wide it took 16 amp. to heat it dull red and then would not ignite gas.

No. 18:- Space $2\frac{1}{2}$"; Electrolyte 1020 sg.
Removed water separator and substituted 2 ft. pipe 2" diam filled with iron wires.
Magnette Plug igniter.

After about 1 minute of gassing, exploded.
Fire came from end of tube

No. 19 – Immediately after – say 10 seconds, closed ignition circuit again and got a good explosion inside the can, with no fire from tube.
So I concluded fire from tube mentioned in #18, is due to gas already in tube, which becomes ignited from flame in cell.

No. 20 – Let gas accumulate for 3 min. Exploded. Fire came from end of tube. Sharp explosion, but can deduct steam amy.

No. 21: Accumulation gas for 2 mins. Exploded.
Fire from tube end.
About same as #20.

No. 22 – 30 seconds accumulation.
Sharp explosion.
Fire from tube.
About same as #20.

No. 23 - Same as #22.
No. 24 - " " "
" 25 - " " "
" 26 ditto.
" 27 "
" 28 "
" 29 "
" 30 "
" 31 "
" 32 "
" 33 "
" 34 "
" 35 "
" 36 " Explosion getting louder.
" 37 " " " "
" 38 " " " "
" 39 No fire from tube. Getting louder
" 40 Was considerable fire from tube
" 41 No fire
" 42 Little fire.
" 43 - Measured Space. Found it to be $3\frac{1}{2}$" now after no liquid was projected from tube. Used up in forming gas.
The proper space for this work is about $2\frac{1}{2}$". Over this, the explosion is too severe.

Nos. 22 to 42 incl. In these experiments I watching the cell closely. When explosion occurred, the sides below armor would bulge out about 1/4" and then in about 1/8" from plane.

No. 44: Let current remain off cell for 20 minutes while I arranged spongy platinum in baskets. Then passed for 15 minutes but no explosion. I now think the spongy Plat. scheme is any good. Even if it explodes once, the hot gas will put it out of business.

No. 45: After removing platinum sponges from Baskets, consuming 20 mins., I sealed up the holes with the plugs and exploded.
No fire came out but the cell took a good load. There was no prop against cell so it jumped considerably.

No. 46: Put current into cell for 6 mins. Let stand 6 mins.
Then exploded.
No fire came from tube but the cell jumped considerably.
The prop was out.

M.47. Forenoon Apr 18/11.
Rigged up overhead crane.
Made 14 explosions, starting with
1" space, using tube separator or
"cooler". When finished had 2"
4/18/11 space. Explosions every minute.
Sharp but can didn't notice
them much.

M.48. At 3:45 PM put about six chemicals
to test do to inflammability, and
4/18/11 whether would float on KOH 21%.
Found one which floated and
was fairly non combustible. It
was Monochlor Naphthaline.

M.49. At 4:20 PM put about ____ cu.cm
of Monochlor Naphthaline in an
4/18/11 E cell equipped with water
separator, magnetic plug &c.
Charged this cell about 5
minutes before putting in the
M. Naph. and exploded.
Then put 28 amp through
cell for 55 minutes to warm it
up and give the M. Naph. chance
to get body. Then exploded
twice, same as if not so.
Emptied cell afterward & washed out.

Entire page 4/18/11.

50. Took armor off big can
and braced the can down well
from overhead crane track.
2¼" space.
51 – Sharp explosion. Can did not bulge
52 – ditto
53 – " louder. Seam between side of
can (right) and top flange had
been opened and some solution is
coming out. Above water line so no
damage.
54 – Ditto. Watched the place indicated
in #53 and noticed some fire
come out there when it exploded.
55 – ditto
56 "
57 "
58 "
59 "
60 "
61 " Watched can closely in this explosion
and found can don't bulge at all
with explosion, where armor
originally was, on this small
space inside can (2⅜").
62 "
63 " Space 2⅜" –

64 – Allowed cell to gas 2 minutes and shut off current. Exploded at end of 5 mins idleness, shattering one jr this space but can did not bulge any near top, maximum appearing to be about half way down.

4/18/11

65 – The can is now considerably bulged from starting at 10" from top and reaching maximum about half way to bottom. The force of this explosion seems to be down.

4/18/11.

The reason the explosion is more severe after shutting off current and allowing cell to remain idle is, the H + O in the water in form of bubbles, acts as a cushion and lessens effect of shock on the solution + immediately the can.

65: Placed a "cundrum" in E-18 cell #21717 and partially inflated same and sealed. Poked it around inside so as to prevent it from sealing up the cell openings.
Placed the small water trap and the spark plug in place.
The cundrum is about 6½" long and 1⅝" diam as inflated.
The cell has not been previously exploded and the dimentions are now 2 9/16 W. X 5" L.
Solution is 9/16 above plates.
Current on cell at 3:12-30 30.5 amp.
Set gas for 10 mins and exploded. Very faint explosion indeed but every condition was right
Opened and found cundrum had been burned by the jar and was flat. Hole about 1" diam. burned out in one side.
Height solution in can increased to 3/4" and decreased in sp. to 1/2" from 1".

66- Having overcharged the same cell E-18 # 21717 so as to get good mixture &c. Placed 61 rubber balls - hollow - into gas space with sol 1/2" above plates.
Exploded volume bubbling 22 a minute. Rather vicious explosion.
Can calipered $2\frac{7}{16}$ wide before
" " $2\frac{3}{4}$ after ∴ $\frac{5}{16}$ bulge.

67 Exploded again and bulged to $2\frac{13}{16}$.
" " " slightly $2\frac{13}{16}$.

68- Hammered sides in with rawhide mallet and put 9 more balls in. Solution 1/2" and separator 1/2" deep as before. Sides little concav. $2\frac{3}{8}$" Exploded. Sides did not bulge at all. Probably sep. 1/2"

69- Exploded. One side slightly bulged for small space near corner (top)

70- Arranged level and sep. Exploded. Bulged a little.

I can see very little virtue in the hollow balls. The explosion is so instantaneous that the can will bulge in spite of the balls. The only service

they render is to take up space and hence decrease the amount of gas. With a good separator and proper internal construction, with less gas space by more solution, I think equally good results can be obtained.

May 10/11.

SMALL TEST CELLS:

6801 A: Made up of four 1/8" tubes grouped around rod.
Tube stock .003"
Loading Wt. Hg .0078 Perforations standard (.0125" X .0175")
" " Fluke .0009 Wt of Hydrate per tube 2.750 Hg. 201634
Fluke #97.
Wt. Dumps - 365 Wt of each tube
Two FeO pockets, supported standard test distance (") from tubes
Standard pocket stock "
Perforations pockets -
Weight each pocket -
Treatment
The two pockets and supports amalgamated as follows, by immersing in $HgCl_2$ 6½% sol. and connecting the two pockets to positive wire from line. a pce. of copper sheet to negative.

6802 A: Same as 6801 A but no amalgamation. To be used as test cell with 6801 A to note difference.

32 6801 A / 6802 A

	6801		6802	
RUNS-	.9 V	.5 V	.9 V	.5 V
1	1717	—	1607	—
2	1903	—	1777	—
3 -	1917	—	1817	—
HOT 4 THRU 53				
54				
55				
56				
HOT 57 THRU 106				
107				
108				
109.				

33

6801 A / 6802 A ~~Repeat same as 6801 A.~~

~~6803~~ no mining ~~6804~~ amalgamated 1 in 9.4 amp.

~~.9 V .5 V .9 V .5 V~~

SMALL TEST CELLS (CONT)

M. 6802 A: Made up of 4, 1/8" tubes, .003" stock.
Standard perforations
Hydrate Weight — Tuk wt.
Two Dum pockets, std. stock
Standard perforations
Pocket weights:
M. Mercury in pockets originally but amalgamated as follows:
Hydrate wt. & same as 6801.

M. 6803 A Same as 6803 A, no mercury in Dum pockets and none amalgamated in or on. Standard cell for 6803 A.
Hydrate wt & same as 6802.

36 6803A + 6822X

	6803X		6822X		
Run	.9 V	.5 V	.9	.5	
1	1713	–	1650		4/21
2	1847		1727		4/22.
3 –	1817		1700		

6803A + 6804A

37

SMALL TEST CELLS (CONT).

M.6100: Made up of 4, 1/8" tubes, 003 stk. std. perf.
Each tube 4 9/16" long (perforations .0125" X .0175")
Goldsteins M.621 Hydrate Burn with
12½% Bismuth. .0069 milligrammes.
Lot M.197 B_2 Stock Ni. flake - .001"
Loaded with M/A tamp machine
21% KOH + 2 gm LiOH (Equiv 1.12 gm LiOH per liter)

Tube M.1 = 410 dumps,	wt.	3.099 gm.
" " 2 = 406 "		3.078 "
" " 3 = 425 "		3.170 "
" " 4 = 421 "		3.142 "
4 | 1662	4 | 12.489	
average 415½ "	----	3.1219 gm

6100 (cont)

Charged at 400 milli amperes - Jn hrs.
Discharged " 250 " × "

Runs -	9/10 V.	5/10 V.	1 V.	Hr
1	2200			
2	2500			
3	2592			
HOT 4 THRU 53			~~1696~~	1696
54	2417			
55	2913			
56	3063			
HOT 57 THRU 106			~~1788~~	1788
107	2300			
108	2625			
109	2855	3021		
110	2730			
111	2895			
112	2833	3000		
HOT 113 THRU				1850.
163	2250			
164	2758			
165	2750	3063		

6781 - 6782 - 6783 - 6784 - 6785 - 6786.
Smiths 1/8" Tubes.

6781 - .003" Strip, Std Recf. 3½% cobalt in Hyd.
Sd. Wr. .0078
#97 Flake - Sd Wr .0009

Charged at 300 Milliampere
Discharged " 200 "

Runs	6781 .9v	6781 .5v	6782 .9v	6782 .5v	6783 .9v	6783 .5v
1	1900	-	1917	-	.1783	-
2	1930	-	1937	-	.1990	-
3	1893	-	1907	-	.1977	-
HOT 4 THRU 53						
54						
55						
56						
HOT 57 THRU 106						
107						
108						
109						

6784 .9v	6784 .5v	6785 .9v	6785 .5v	6786 .9v	6786 .5v
1790	-	2067	-	2057	-
1990	-	2423	-	2420	-
1983	-	2440	-	2440	-

Special 17-18-19-20-21.

52

Charged & Discharged

	Sp. 17		Sp. 18	
	.9 V	.5 V	.9 V	.5 V.
RUNS				
1	1700	–	1750	
2	1827	–	1857	
3	1920	–	1997	
HOT 4 THRU 53		483 TO I.V		490 TO I.V.
54	1953		1983	
55	1950		1987	
56	1877	1903	1937 - 1963	
HOT 57 THRU 106		640 T. I V.		620 T. I V.
107	2033 –		1967 –	
108	1980		1920	
109				

300 m.a.
200 " "

53

	Sp. 19		Sp. 20		Sp. 21	
	.9 V	.5 V	.9 V	.5 V	.9 V	.5 V.
	1787		1750		1777	
	1960		1960		1907	
	1980		2010		1960	
		547 TO I.V.		507 TO I.V.		520 TO I.V
	2047		2017		2087	
	1997		1943		2033	
	1963 - 1997		1897 - 1940		2007 - 2043	

Cell Sp. 9

54 – 7/8" std pump + std tubes for pump
Thompson 432 tubes to the cell.

RUN	CHG.	Disch	Sp. G 1V	Sp. G 2V	Remarks.
1	30 hrs @ 20	@ 30	183	186	On first 5 mins, cell was discharg to .5 V after which [illegible]
2	15 " " 30	"	186.5	189	
3	"	"	173.2	173.5	
4	"	"	174.2	175.2	
5	"	"	168.2	169.1	
6	7 hrs @ 30	"	161.2	166.5	
7	"	"	157.5	160.2	
8	"	"	160.2	160.5	
9	"	"	158.5	158.7	
10 -	4⅔ hrs @ 45	"	158.7	159.2	Previously [illegible]
11 -		"	160.5	160.7	
12		"	165.	166.5	
13		"	159.2	159.7	
14	3½ hrs @ 60	"	162.5	163.	
15	"	"	162.	163.	
16	"	"	162.7	163.3	
17	5 hrs at 60	"	173.7	174.5	
18			176.7	177.2	
19			178.5	180.	
20			177.	177.5	
21			177.2	178.	
22	5 hrs @ 60	"	630.	181.5	
23	" "	"	182.2	186.7	
24	" "	"	185.5	181.	
25	" "	"	180.	183.5	
26					

Run	Sp. G Disch 1V.	Sp. G 2V	
27	185	186	
28	187	187.5	4 hrs @ 75 amp.
29	186.8	187.	3 hrs. 28 min @ 75 amp
30	190	190.7	40 min @ 60
31	188.7	190.0	= 300 AH. for a 4 stg.
32	187.	188.5	
33	191.	192.	
34	185.2	186.7	3⅓ hrs @ 90 amp.
35	192.	193.	do. 10 min, Rest 1½ hrs.
36	192.2	193.	
37	188.	189.5	
38	191.7	193.	
39	190.3	191.	
40	190.	191.7	~~5 hrs @ 90 amp~~
41	198.	199.	5 hrs @ 90 amp. 44.2%
42	202.1	203.	" " 45.1
43 -	203.2	204.2	45.4
44	205.5	206.5	45.9
45	201.5	202.7	45.1
46	197.	199.	44.2
47 -	206.2	207.5	46.1
48 -	205.2	206.5	45.9
49	200.5	202.5	45.
50 -	202.2	203.7	45.3
51 -	206.7	209.	46.5
52 -	202.5	204.5	

	1.	.9	½V.	
53 –	201.2	203.5		
54 –				4 hrs @ 100 amp. 2 disch, @ 200 amp.
	83.3	140.9	193.6	ditto
55	83.3	145.	201.6	"
56	83.3	153.3	190.	"
57	66.6	150.	205.	"
58 –	83.3	147.5	208.3	"
59 –	71.6	150.	200.8	
60 –	88.3	156.5	206.6	chg 5 hr. @ 100.
61 –	71.6	153.3	203.3	
62 –	76.6	163.3	211.6	
63 –	88.3	150.	220.	
64 –	85.	175.	221.6	
65 –	90.	180.6	215.	
66 –	90.	170.	200.	chg 4 hrs @ 125
67 –	78.3	150.	193.3	
68 –	83.3	176.7	220.	
69	83.3	183.3	210.	
70	83.3	183.3	226.6	
71 –	100.	185.	219.1	
72	91.6	185.	210.	
73	90.	183.3	215.	
74	88.3	175.	210.	
75 –	100.	186.6	215.	
76	103.3	183.3	216.6	
77 –	83.3	175.	211.6	
78 –	90.	168.3	211.6	

	1.	.9	.5	chg.
79 –	91.7	185.	210.	
80 –	73.2	156.7	203.2	
81 –	100.	166.7	208.3	
[illegible] –	at end of 35 min. V=		at end –	With { chg 4 hrs @ 100 amp disch 35 min @ 200 "
82 –	.95		116 2/3	
83 –	.95		"	chg 1 hr @ 200 disc 35 min. @ 200.
84 –	.94		"	
85 –	.92		"	
86 –	.92		"	
87 –				" "

Special Cell No. 10.

April 27/11.

1/8" tubes – 56 tubes to each position. 448 tubes.
In an A^s can.
Put in 1800 cc. 21% KOH + 50 g. LiOH per liter & then filled to proper height with straight 21% KOH.
After soaking 6 hrs or more to give one running charge 20 hrs @ 40 amp, followed by 4 runs charging 10 hrs @ 60 amp.
Discharg. in each case 30 amp to .5 V.
Then give 5 or 6 runs chg. to 5 hrs @ 60 amp & discharg @ 30 amp to .8 V.

Sp. 10

Run	Charge	1 V	.5 V	% AH Eff.
1	20 hrs @ 40 amp	206.5	207.2	25.8
2	" "	198.5	201.	33.5
3	10 hrs @ 60 "	187.2	188.5	31.4
4	" "	194.5	196.	32.6
5	" "	204.	205.5	34.2
6	" "	187.	187.7	62.5
7	" "	194.7	195.5	65.2
8	" 90	208.2	209.2	46.5
9	" "	205.2	206.	45.8
10	" "	208.2	209.7	46.6
11	" "	208.	209.5	46.6
12	" "	206.5	208.2	
13	" "	207.2	209.2	½ V
14	4 hrs @ 100 amp, Discharge 200 amp	83.3	145.	200
15		83.3	140.	206.6
16		83.3	150	196.6
17		75.	145	211.
18		88.3	149.1	215.8
19				
20.	5 hrs @ 100.	100.	166.6	228.3
21.		81.6	156.6	211.6
22.		83.3	166.6	224.1
23		93.3	163.3	233.3
24		100.	178.3	243.3
25		105.	183.3	226.6

		1 V.	.5 V	Eff.
26	4 hrs @ 125	103.3	196.6	233.3
27.		83.3	161.6	228.3
28		100.	180.	231.6
29		100.	195.	233.3
30		86.6	200.	253.3
31		116.6	193.3	230.8
32		121.6	198.3	220.
33		116.6	196.6	225.
34		113.3	191.6	215.
35		116.6	196.6	203.3
36		115.	200.	223.3
37		116.6	188.3	216.6
38		113.3	185.	208.3
39		125.	195.	215.
40	note, corresponds with #40 of the Sp. 9.	116.7	176.7	206.7
41		141.7	186.7	203.3

	Chg. 4 hrs @ 100, Disc. 35 min @ 200.	V.	Wt.
42		1.01	— 116 2/3
43	Chg. 1 hr @ 200, Disc. 35 min @ 200.	1.00	"
44		1.00	"
45		.98	"
46		.977	"

6837-8-9-40

6837: .003 stock, Perforations .007 X .015
Hydrate #1634. Loading Wt. .0078
Flake # 97 cut .050" Sq. Ld. Wt. .0009
Average Dumps 365; Av. Weight same 2.75
8 Rings

6838: Same as 6837 except
average Dumps 365
" Wt. " 2.75

6839: .003 stock - 8 rings;
Perforations .007" X .015"
Hydrate Wt. 621, with 12½% Bismuth
Loading weight .0073 g. Hydrate
Flake #97, cut .050" sq.
Loading weight .0009 g
Dumps, av. 352
Wt " " 2.94 g

6840: Same as 6839 except
average Dumps - 352
av. wt. " 2.94

	6837		6838		6839		6840	
Run.	.9v	.5v	.9	.5	.9	.5	.9	.5
1	1743	–	1810	–	2053	–	1933.	–
2	2033	–	2100	–	2500	–	2387.	–
3 –	1983		2067	–	2517	–	2450.	–
m.								

6883 – 6884

4/22/11.

Orig. 400 } Long tube rate.
Siech 200 }
Potassium Chloride put in as burning agent 10g. to the cell.
.003 stk - pulverizing .007X.015
Hydrate No. 1634
Flake No. 97
Sample wt of Hydrate .0078
" " " Flake - .0009
No 1-2-3-4
347-327-327-319 Samples

Wts	1	2	3	4
	2.765	2.747	2.779	2.775

Four rings per tube —
Standard Sol. with 10g. pott. chl.

6884 – Same.

	6883 .9	6884 .9	
1 –	1896	1813	
2	2000	1854	Put in 10 gr. Pt. Chl. pr. ac.
3	2038	1908	
4 –	2046	1917	No trusting yet
5 –	2083	1967	Seems flaring
6 –	2108	1992	
7 –	2167	2029	Starting to swell.
8 –	2213	2133	
9 –	2175	2113	
10 –	2246	2171	
11 –	2258	2238	
12	2308	2283	No break yet.
13 –	2396	2292	
14	2438	2354	

5272 A to 5283 A.

To Determine Number of turns of Seam.

5272 A: 003 Stock, Straight Seam.
Ni. Hydrate 1256 Ld. Wt = .007
" Flake 197 B2 " " .001
Average Dumps = 383,5
Aver. Wt. " 2.8345

This series of cells had 33 runs normal cold and were then run on Hot Test. In 35 runs after which they were filled with 21% KOH + 2 g. LiOH + allowed to soak over night. Fresh 21% KOH + 2 g. LiOH was then put in and run regular.

Run # 76 — .9 v = 1813. #77 = 1750, #78 = 1792
Condition after being taken off, as follows:

5273A: .003 Stock, 1/2 Turn.
Same as 5272 otherwise.
Av. Dumps: 378. Wt = 2810 g
76th num = 1917. 77th 1867. 78th 1888.
Condition:

5274A: .003 Stock One Turn.
Same as 5272A otherwise.
Av. Dumps: 383. Wt = 2,843 g
76th num = 1729. 77th 1642. 78th 1692.
Condition

5275A: 003 Stock. 1½ Turns.
Same as 5272A otherwise.
Av. Dumps: 374. Av. Wt = 2.853
76th 1663. 77th 1583. 78th 1617.
Condition:

5276A: 003 Stock. 2 Turns
Same as 5272A otherwise
Av. Dumps: 387 Wt = 2,879
Condition:

5277A: 003 Stk. 2½ Turns. Letter 5272
Av. Dumps: 380. Wt = ~~3,845~~ 2898

5278A: .005 Stock Straight Seam.
Same as 5272
Av. Dump = 348. Av. Wt = 2,571
76th - 1738. 77th = 1683. 78th 1721
Condition -

5279A. 005 Stock - 1/2 Turn.
Same as 5272 otherwise.
Av. Dumps = 332. Wt = 2,521
76th 1833. 77th 1804. 78th 1833.
Condition:

5280A: .005 Stock, 1 Turn.
Same as 5272 otherwise.
Av. Dumps - 333 Wt = 2,541
76th 1779. 77th 1733 78th 1767
Condition:

5281A: .005 Stock. 1½ Turn. do. 5272.
Av. Dumps 335. Wt 2,544
76th 1804. 77th 1767 78th 1792.
Condition:

#5282A. .005 Stock . 2 Lumps.
Av. Lumps = 337. Wt. 2.592
76th = 1804. 77th = 1767 78th = 1742.
Condition:

5283 A: 005 Stock 2½ Lumps.
Av. Lumps = 340. Wt = 2.612
76th = 1750. 77th 1696 78 = 1721.
Condition:

Sp. #1

Bismuth 1/8" tubes -
1500 @ C 21.50
745 " 21% KOH.
Item 2140 - C C. —

Ctg 8 hrs. 30 amp. and 14 hrs @ 40 amps
20 hrs @ 140.

		1.	.9	.5	
1 -		237.2	237.7	239.5	
2 -	Ctg 10 hrs @ 60.	270.5	271.5	276.5	20 cells @ 30 amp.
3 -	" "	267.5	268.	269.	
4 -	" "	269.5	270.	270.5	
5 -		273.5	274.	275.	
6	5 hrs @ 60 disc at 30.	221.5	222.		
7	2½ @ 30 + 3½ @ 60 5 hrs @ 30 -	225.	226.5	227.5	
8 -	5 hrs @ 90 -	242	243.5		
9 -	" "	245.7	246.7		
10 -	" "	234.5	235.5		

7077 + 7078 May 11/11. 91

1/8" tubes -
10g. KCl pencil -
8 rings -
Chg - 15 hrs @ 400
dish [redacted] 200

	7077	may 11/11	7078
	.9		.9
1	2046		1954
2	2200		2042
3	2063		1996

in hand

Overcharge Alarm.

May 2/11.

After charging until P.D. = 1.75, I short circuited the cell for 10 mins @ 95 amp. Then started in to get a line on the "bubbler".

Charged @ 30 amp. Bubble water at electrical main current on at 4^32 PM. At 4^35 5½ bubbles per minute.

At 5^25, 25 bubbles per min.
" 5^27 30 " " "
" 5^51 33 " " "
" 6— 35½ " " "
" 6^10 39½ " " " P.D. = 1.8
" 6^30 rheostat opened up.
" 6^35 current on.
" 6^45 Rheostat opened up
" 6^55 current on.
" 7— 41½ B.p.m. P.D. = 1.82
" 7^5 42 " " " " 1.82
" 7^10 49 " " " " 1.82.

then current off. turned to drainer

Before throwing off I filled alarm with water so it would ring at this gassing. Has 3 holes open in top row each .050"

8^50 PM. After 1 hr. 30 min. M. EMF = 1.51 V.
8^53 V = 1.1 C = M scale of 100 amp.
8^55 " 1.05 C = 98
8^56 " 1.03 C = 96
8^57 " 1.02 " 94
8^58 1.01 92.5
8^59 1. 91.
9 1. Bubbles 1^m 25^sec 90.
9^1 .995 89.5
9^2 .99 89.
9^3 .98 88.5
9^5 .975 87.5
9^10 .96 86.5

Bubble every 1^m 25^sec
mean C = 84.4.
Time = 17 mins = 16.88 a.H.

9^10 Circuit Opened. V = 1.24 going up.
9^17 " V = 1.38 — added H2O 1" above plates.
9^18 circuit on (30 amp) V = 1.575 C = 30.5
9^20 V 1.575 C 30.5
9^21 — 3 bubbles per min.
9^25 V = 1.64 C = 30.
9^26 5½ B.p.s.
9^30 1.69 30.5
9^40 1.722 C = 30
9^50 1.74 C = 30.3
10 1.745 C = 30
10^10 1.77 30
10^15 1.79 30
10^20 1.805 30.2

alarm sounded. Removed tube and cleaned out the 3 holes. Forming gas & blow contents when no gas.

8½ bubbles per min.
10½ " " "
14 " " "
21 " " "
28 " " "
36 " " "

10^25 181.2 29.7 41 Bubbles.
Bell Rings
10^26 181.8 43 "

Depth of water in tube, all parts immersed = 3¾"
300 c.c.

10^40 181.5 30.2 43 bubbles.
Bell Rings.
Winters cell @ 10^43 M scale @ 100 amp (1203)
10^45 V = 1.095 C = 99. } 4 cells
10^47 1.64 31 amp.

18867-A

1- Single Ni. plate from A & Cell 18867.
2- Composed of 1/4" Dubs, std, with Hydrate + 12½% Bismuth.
3- Glass Insulation between plates and on edges &c.
4- all in an 8" can of std KOH + 45 g. Lithium in Cell.

Run	A4 Equiv. 1 V.	.5 V	Bismuth ~~m.a.h. pr.~~ 1 V.	.5 V	Efficiency
1.	208.	240.	1732.	2000.	53.3
2	245.	270.	2040.	2250.	60.
3	260.	268.	2165.	2233.	59.6
4	254.	264.	2118.	2200.	58.7
5		.9 V		.9 V	
6	183.5	184.	1529.	1532.	87.6

May. 4. 1911.

Chg. 15 hrs. @ normal at rate = 7½ amp (for plate)

" 7 hrs. " " " " " "

May 15 – off circuit discharged. Held on for further insulation cell.

Oxidation &c of Nickel

Object

To determine best method of rendering the grids of Edison cells dielectric

Strips of pure Ni. were prepared, each 1/2" x 2 ft. These strips were treated as indicated below and prepared for polarization test.

I - Alumina, dipped by J.A.E. Deposit (not electrolytic) of white substance, very irregular, and lumpy. Not very satisfactory appearance.

II - Same as I.

III - IV - V - VI - Painted with burn Fe_2O_3 and baked. N.S. - cast aside

VII - Cathode in Bath of Cobalt Sulphate with ammonium oxalate. Very dark Brown coating, very tenacious. About 1 amp.

VIII - Anode of VII

IX - Cathode, Cobalt Sulphate only. Fog charge at 1 amp. Fair cobalt deposit. Small small pin head spots of dark color.

Results

Connected in series on DC. 110 V. circuit in series with 16 cp lamp.
C = .365 m. amp.

I =
II =
III –
IV –
V
VI
VII – 2.2
VIII – 2.42
IX = ~~2.14~~
X = 2.14
XI = 2.46
XII = 2.14
XIII = 2.36
XIV =
XV =
XVI =
XVII = 2.64 = 1st
XVIII = ~~2.46~~
XIX = 2.46
XX = ~~[illegible]~~
XXI = 2.5 2nd
XXII = 2.42
XXIII = 2.38

X – Anode of IX. Black appearance, spotted – irregularly deposited. bottom and almost clean

XI – Cathode, cobalt sulph only. short charge @ 1 amp. Nice cobalt deposit.

XII – Anode of XI. Brown, light deposit. Edges clean.

XIII – Cathode, Analine chloride 50 gm. in 100 cc H_2O. Reddish color, fair deposit.

XIV – Anode of XIII. Brown-Black appearance. all sides exc. other side streaked.

XV Cathode $FeSO_4$ acid. with H_2SO_4
XVI Chg. 320 m.a.

XVII Cathode Sat. Sol $FeSO_4$. 300 m. amp. nothing doing. Sr chg 2½ min with 300 MA. in weak Sol., sp. 1050. Red appearance

XVIII Anode through XVI + XVII oxidized in flame. Reddish brown - pimpler spots.

XIX - Cathode ng nickel metal

XX - dittor ng discard

XXI Cathode 300 ma. for 4 min in 10% - 7 & 50% - Reddish streaked - not very good looking.

XXII Cathode in cobalt sulph sol only. Fine deposit of cobalt, mixed not oxidized in KOH. So oxidized with flame. Sulph 1/4" with thin stick.

The results from above were not very satisfactory + the tests should be made over.

Suggestions of Jae as to preparation of dielectric nickel

No. A - Plate cobalt. Then use 2 for anode & cathode in KOH 21% & 2% Li. Run until Co. oxidizes thoroughly, then take drop #2.

No. B. - Varnish strip for 1" with Colloidal Fe_2O_3. Dry at 212° for 30 min. Take Pot. Voltage.

No. C - Iron plate and then oxidize by making anode

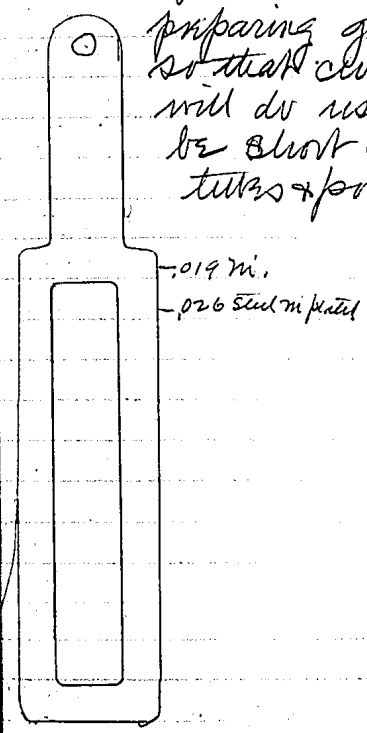
No. D. - Put 4g. Vanadic acid in 100 c.c. 21% KOH & 2% Li. Pass current for 2 or 3 hrs. Wash & polarize in 21% KOH & 2 Li.

No. E. - add 5g. aniline chloride to 100 cc H_2O. Separate aniline. Bleach on strip. Wash & test as before.

Nr. F. - add 4g. metallic aluminum to 100 cc KOH2Li - till all dissolved. Put current on strips for several hrs till precipitates so much current goes way down.

Nr. G. Try chloride alumina, Ni. anode. Lead cathode 50 to 100 m. amp. for 5 mins. Soak Ni in H_2O + try in KOH2c.

To produce a dielectric film around test plates of size & as sketch, with view toward preparing grids of Edison cell so that current passed through will do useful work and not be short circuited by the tubes & pockets.



1.75
6.25
8.75
3.50
200 | 105.0
30 over | 1.09 3.75
144 | 285
12

③ Polarization = 1.95 P.D. 300 ma. on 4 ½ cent.
Removed, using as anode on
250 ma. & found 2.1 P.D.,
Solution turning red.
Put stream as anode for 5 min & comm
over black. Sol, slightly red.
Put in same sol as cathode again
for 5 mins. 1.95 P.D.
Made anode 5 mins. P.D = 2.1, Breaking down
Put 5 mins as cathode. P.D = 1.985
Not good. Pulsating.

Dielectric

We will first experiment on nickel strips, scrap - to
5/8 W X 1 3/4 l.
Placed 2 of these 2" apart into a bath of $FeSO_4 + H_2SO_4$,
S.g. 1050. Passed 250 m.a. nothing doing
① much at end of 10 mins. So added 10 c.c.
H_2O_2, turned reddish yellow.
Deposited a fair coating of iron at 10 min
on cathode but toward bottom was bad.
2 — So discarded solution and cathode.
Made-up new solution and used new
cathode. Going to cathode & anode
not being in sol. very long, so nickel
was dissolved + strength 3 cells
necessary. But result very
poor. So
3 — Ran current up to 300 m.a.
by placing electrodes 3/4" apart.
Got a fair deposit, rough + looks
like metallic Fe.
Placed as anode in KOH bath
and plate commenced to clean.
So took out & rinsed over a flame.
Pretty good. Deposit good enough
to prepare test piece.

5 – 1.83 @ 50 m.a. for 2 min.,
charged to anode for 5 mins – 1.920 P.D. at
begin & 1.945 at end of 5 mins.
Charged to ~~anode~~ cathode ... P.D. = 1.85
at first – 1.82 at 3 min & 1.80 @ 5.

4. – Made up Ferrous Am. Sulph. sol., 1050 s.g.
@ 70° Fahr.
Ferrules 1 3/8" apart.
Chgd @ 140 m.a. for 5 mins & turned
cathode around & for 5 mins more, then
removed lower again.
Peeling off at bottom of edge. N.G.

5 – Tab suggests 1/3 amp density
per sq in. = 56/3 = 19 m.a. – say 20.

Pce is 2.62 sq in. × 19 ma = 50 ma.
for 1 min. on each side.
Steamed with Fe, no grid, not
long enough chg. so

6 – Charged to 2½ min on side. (~~50~~ m.a)
after cleaning in KOH as cathode.
are 1 3/4 × 5/8 = 2 sq in. = 38 m.a
Better but not enough, so

7 – Chg. 5 min each side @ 38 ma.
after cleaning in KOH. &
mottled.

Ex. over Hom.

Result

M.1 - Placed 1 + 2 in KOH 26i.
M.1 was anode.
" 2 " cathode.
Put 210 m.a. through
V. jumped to 1.9, + remained.
Reversed, showing #1 as cathode
#2 " anode
Ran up to 1.2 for 3 or 4 seconds
Jumped to 1.82 + remained.
Reversed. #1 as anode
#2 " cathode.
Ran up to 1.9 + remained at 1.93
Reversed. #1 as cathode
#2 " anode
Ran up to 1.83 and remaining.
Let 1 + 2 remain in KOH over night.
appeared to have lost almost all of coating
Solution red dish looking.
Put on with 210 m.a.
with M.1 as anode } P.D. = 1.95
" 2 " cathode.
Reversed with 1 as cathode } 1.97
2 " anode
Reversed " 1 " anode } 1.97
2 " cathode

Send up to Fast Room.

Distillate

Bird #1. 20 mins. in dilute Sol Sodium Chromate. As anode. Placed in oven 15 minutes.

" #2 20 mins in Strong sol Sodium chromate. as anode. Baked 15 mins.

3 -

Results

#3. 200 m.a. 1 nickel strip
#3 cerium strip.

PD 2.12 { #3 as anode / Ni. " cathode } Sol KOH. 2 li.

2.01 { #3 " cath. / Ni " an } 5-min

1.92 { #3 " an / Ni. " cath } 5-min.

1.95 { #3 " cath / Ni " an } 5-min.

Deposit of oxide wiped off to great extent

Will make another grid for test thickness as 3-A.

No. 3 — Made up { 200 c.c. H_2O / 11 gm. Cerium acetate }

Placed in Sol. as anode
1 minute @ 150 m.a.

Pol. Results.

$9^{\underline{8}}$	4 as Cathode -		2.01
		to	1.85
$9^{\underline{12}}$	4 " Anode -	"	1.85
		"	1.97
$9^{\underline{17}}$	4 " Cathode	"	1.87
		"	2.01
$9^{\underline{38}}$ -	4 " anode	"	1.9
		"	1.93
$9^{\underline{58}}$	4 " Cath	"	1.88
$10^{\underline{18}}$			2.

N Jn test up

Raised Slowly from solution - keeping current 200 m.a.

all in -	2.00
up $\frac{1}{2}$"	2.03
" 1"	2.06
" $1\frac{1}{2}$"	2.1
" 2"	2.15
" $2\frac{1}{2}$"	2.25
" 3"	2.43 Barely touching sol,

Nickel grid

No. 4. Sol. { Cerium Nitrate 10g.
H_2O. 200 cc

pur through 100 m.a. for 3 minutes with # 4 as Cathode, Beautiful crystals. Dehydrated. Fine.

After Pol. tests, dried & under microscope looks fine. Perfect surface.

Results

11 20 pm	#5 as cathode	to	1.85
11 26		"	1.92
	out.		
12 45	#5 as cathode	"	1.925
			1.93
12 54	5 as anode		1.87
12 59			1.83
12 59	5 " cathode		1.88 going up

M + Mgr upstairs –

M. 5 – Drow, nickel plated.
Same sol. as #4.
100 ma. for 3 mins. as cathode.
Beautiful coat.
Dehydrated.

Results

11 40	#6 as Cathode	to	2.06
12 2	"	"	2.2
12 3	#6 as anode		1.87
		"	1.87
12 7	#6 " Cathode	"	1.9
12 15		"	2.02
12 15	" anode	"	1.94

No. 6 Nickel grid.
Same sol. as 4 + 5
100 ma. for 3 mins. good.
SrO_2 hydrated.

When dehydrated had several spots. Sr cleaned off + put through Sol. for 3 mins again.

Pol. Results

6 16.	200 ma. 7 as anode – Nickel cathode	P.D. =	2.11
6 19	–		2.12
6 19	Reversed – 7 as cathode, 11 as anode	up to	1.9
6 22			1.96
6 22	Reversed 7 as anode	to	1.86 Rem
6 25	" 7 " cathode	"	1.89
		"	1.91
6 25	" 7 " anode	"	1.86
		"	1.84
6 31	" 7 as cathode	"	1.88
			1.91
6 36	" 7 as anode		1.86
			1.83
6 41	off		
6 43 –	7 as cathode	–	1.88
9 PM	After 2 hrs 17 min		1.89
	off & put away.		

No. 7 Iron Brief
Same Sol as 4, 5, + 6.
100 ma for 3 min Brief
well cleaned on edges.
Dehydrated
Oxidized in flame.

Results Polarizn.

10 40	#8 as Cathode.	to 1.94
10 50		" 1.99
10 53	Rev. #8 " anode	" 1.87
1		1.82
10 58	#8 as Cathode	" 1.87
		1.93
11 8	" anode	1.83
11 11	" Cathode	to 1.85
11 20	off	1.90

Seed upslants.
Current appears to have
amply bur. Nickel surface.

Nickel gauze

No. 8 — Sol. 6 g. Sod. Vanadate —
200 cc. KOH + 2 Li.
30 ma. for 5 min.
as anode.

Results

12^{15}	9 - as cathode -	to	1.94
			1.94
12^{24}	9 as anod	"	1.92
		"	1.85
12^{30}	9 as cathode		1.92
12^{36}			2.025
12^{36}	9 " anode	to	1.92
			1.89
12^{42}	" " cathode		1.92
$-^{46}$			1.98

off + acids for upstairs

No 9 - Nickel grid -
Sol = { 6 gm Iodide Potass.
S701 { 200 cc KOH 2 Li
3 min. 50 m.a. as cathode.
no discoloration so put on
3 min @ 50 m.a.

1.30	cathode	1.965
1.38	anode	1.91
	tr	1.84
1.39	cathode	1.9
1.41		1.92
1.41	anode	1.86
1.42		1.84
1.42	cathode	1.86

[illegible] good -
[illegible] seal up.

#10 - Nickel Grid

Sol. { Sulfate Soda 60 gm
{ KOH - 2 Li - 200 cc

6 min @ 50 m.a. as Cathode
Hydrated in steam oven.
Put in KOH to wait.

Results

May 20

1:3 a.m.	#11 as Cathode —	to 1.99
1:6		1.97
1:6	11 as anode —	to 1.86
1:9		1.83
1:9	11 " cathode —	1.88
1:17		1.95

off. for lists.

#11 — Sol (103) { Molybdate Soda 6g. KOH 2Li 200cc as Cathode

6 runs @ 50 m.a.

Dr. orm.

1.19	12 as cathode -	1.93
1.23		1.94
1.23	" anode	1.92
1.26		1.85 -
1.20	" cathode	1.87
1.36		1.95 -

Nickel grid

12 - Sol (104) Jungsdate Soda 6 g.
KOH + 2Li - 200 cc
6 min @ 50 m.a. Cathode
Chem -
Sutn KOH to wash

May 20

1.44 am	cathode –	1.94
1.47		1.95 –
1.47	anode	1.88
1.50		1.84
1.57	cathode	1.88

Burn – upstairs –

13 – Sol (100) arsenate Soda 6 g.
KOH + 2Li – 200 cc
6 min @ 10 m.a.
as cathode

Trial Combinations
Suggested by Mr Edison 5/19/11.

Basis to each 100 cc of 21 KOH 2 Li add 3 gms.

Iodide Potassium S-101
Silicate Soda S 102
Vanadate Soda K or NH4 -
Molybdate Soda - S-103
Chromate Potash
Tungsdate Soda S-104
Arsenate Soda (look out - Violent poison, Arsenuretted Hydrogen) good Radiation - S 105
Metallic aluminum 1 gm only per 100 cc -
Antimonate Potash
Polysulphide Potash 2 gms per 100 cc
Acetate of alumina -
Iodide Potassium 100 cc 21% KOH + 2Li + 6 gm Iodide Potassium. } 106

Iodate Potassium 1 gm KIO3 to 200 cc H2O. S-107

KOH + KI

4:32	as anode -	2.13
4:29		to 2.2
4:39	as cathode	1.98
4:53		to 2.09
4:53	as anode	1.92
5:12		2.0v-

grn. upstairs:

May 23/11.

Put in as cathode at 10:30 PM.
11:30 " 2.1v- cathode.
12- 2.06 amps

use as anode only:
Put new sol in
Put in 200 ma. for.
analyze sol,

#14 - Sol #101 + 50 cc H_2O.
6 min @ 50 amp
as anode
no apparent discoloration except
at top. So
Put in as anode 6 min @ 100.

OWV

In Sol 101 Iodide Potass

101 — Ni. Strip .025" X .5" X 3 in sol = approx 3 sq. in.
at 150 m.a. for 6 min.
in Potass Iodide. sol.
Not previously washed in tet chl
Caution — grease (?)

102 — Same as 101 but washed
in tetrachloride Caution,
washed & put in KOH.
150 m.a. for 6 min.

103 — Same — but
150 ma for 7 min.
104 — 8 min
105 — 9 "
106 — 10 "
107 — 5 "
108 4 "
109 3 "
110 2 "
111 1 "
112 ½ "
113 ¼ "
114 — ½ Ohm dilution Cathodes on all the above.
115

In Sol. 1.01 Iodide Pot.

116 – 300 m. amp for 1/8 mins.
117 – " " " " 1/4 "
118 " " " " 1/2 "
119 " " " " 1 "
120 " " " " 1 1/2 "
121 " " " " 2 "
122 " " " " 2 1/2 "
123 " " " " 3 "
124 " " " " 3 1/2 "
125 " " " " 4 "
126 " " " " 4 1/2 "
127 " " " " 5 "
128 Cathods of all above – 116 to 127 incl.

129	450 m. amp.	for		2 1/2 seconds.	
130 –	"	"	"	5 seconds.	
131	"	"	"	10	"
132	"	"	"		

129 – 450 ma. for 2 1/2" (1/39 1/8)
130 – " " 5" (1/39 1/4)
131 – " " 10" (" " 1/2)
132 " " 33 1/3" (" " 1)
133 " " 40" (" " 2)
134 " " 1' (" " 3)
135 " " 1'-20" (" " 4)
136 " " 1'-40" (" " 5)
137 " " 2' (" " 6)
138 " " 2'-20" (" " 7)
139 – 2'-40" (1/39 8)
140 – 3' – (1/39 9)
141 – 3'-20" (" " 10)
142 Cathods for all above (129-141 incl.)

– Area –

Each "A" Positive with its 1/4" tubes (30 of them) has an area of metal exposed to electrolyte contact of 153 sq. Inches.

Thus an A+ has 612 sq in grid area. This takes into consideration all surface, allowing the sides of holes or perforations in tubes as being equal to area of hole.

612 sq. in @ 30 amp charging rate is at rate of 20.4 sq. in. per ampere or 50 m.a. per sq. inch.

~~[illegible] 150 ma 10 min~~

143 – Sol. 106 – 10 min with 300 ma
144 – Straight nickel – no heat –
145 – Sol 106 10 min with 600 ma
146 – " " 20 " " 300 "
147 " " 20 " " 600 "
148 " " 1 12 sec – 1000 "
149 " 107 5 min – 150 "
150 " " 10 " " "
151 " " 20 " " "
152 " " 2½ " 300 "
153 " " 5 " " "
154 " " 10 " " "
155 – " " 1-12 sec 1000 " (stir)
156 – " " 2-30" " " "
157 – ~~Straight nickel~~ cathode of all arm – – – –
158 – Straight nickel – in new sol (nickel cath)
159 " " " 2m "
160 " " " " " " anode

Instructions for Runs

– upstairs –

Place a numbered strip and an unnumbered strip in each jar.
Pour solution in until exactly 2½" of strips are under.
Make all numbered strips anode on first run.

Put 125 m.a. through for 15 mins.
Take drop around each cell at end of 15 mins record.
Reverse current.
Put remain reversed for 15 mins.
Take drop around each cell again record & not until further notice.
Begin on one exactly on hour. Stop at 12. On at 1 – off at 6 – on at 7 30 off at 12.

[illegible]

May 22/11.

New Strips – wire welded on –

501 –	300 ma for	20 mins	as	anode	S-101
502	" "	"	"	Cathode	S-101
503	" "	"	"	anode	S-102
504	" "	"	"	cathode	"
505	" "	"	"	anode	S103
506	" "	"	"	Cath	S103
507	" "	"	"	anode	S104 – 6gm + 100
508	" "	"	"	Cath.	dr
509	" "	"	"	an	S105 dath
510	" "	"	"	cath	dr
511 –	" "	"	"	an	5108
512	" "	"	"	cath	"
513	" "	"	"	an	5117
514	" "	"	"	cath	"
515 –	Plain Nickel anode,	3mv cathode			
516	" "	Cathode	"	anode	
517	300 ma. for 20 min		as	anode	Sol. 109
518	" "	"	"	cath	
519	" "	"	"	anode	Sol. 115
520	"			cath	
521	"			anode	
522				cath	Sol. 119
523	dr			an	" 120
524	dr			cath	
525	dr.			an	S.-121
526	dr.			can	

~~Sol. 10 gm Cobalt Nitrate 600 cc. H_2O.~~

~~#16 – 150 m.a. for 6 min as Cathode~~
~~#17 – " " " " " anode~~

Electrolyzed a sol. of potas. iodate (12 gm to 200 cc H_2O) using 2 Ni strips. Free iodine formed immediately at the anode and nothing appears on the strips after washing, even after prolonged electrolysis in the iodate (16 min). To circumvent the liberation of free I, added KOH + 2 Li sol in small quantity. On electrolysis, the current (150 m.a.) passed without difficulty but absolutely no gas formed at either pole. The reaction probably proceeded as follows. The KIO_3 was decomposed with liberation of free I. This free I immediately combined with the KOH thus regenerating the original substance KIO_3 and water. The electrodes in this latter case failed to show any indication of coating also.

527– 30v m a 7p 20 min. Cm } Sol 122
528 Calth }
529 - - dv. Cm } S-101-A
530. Ca. }

1 B2 Standard except
Place in glass jar
Use no insulators or
separators.

D

1-B2 Bismuth tubes
Oxidized grids -
" Connectors
" Washers 2
" Nuts
Glass jar
no insulators or separators.

C

B

1 B2 with
Oxidized grids, contacts clean
" connectors except bus.
" washers on periphery
" nuts, polished contacts
" can
Standard pockets
" Tube trip
Make up complete in can

1-B^2 Oxidized grids
" Connectors except bus.
" Washers on outer periphery
" Nuts polished contact side
" Pockets cleaned inside + out
" Tubes, cleaned inside + out.
" Rings.
" Can inside.
Make up complete with standard solution but not formed.

1 B^2, oxidized grids pockets + tubes, all ~~contacts~~ cleaned. ~~No insulators~~ made up in B^2 Can complete but not charged or formed
1- B^2 oxidized grids only with standard pockets + tubes made up complete
1 B^2 ~~all parts standard but made up in glass jar with no insulators.~~
1 B^2 with Bismuth tubes made up in standard grids no insulators
1 B^2 with Bismuth tubes with Oxidized grids

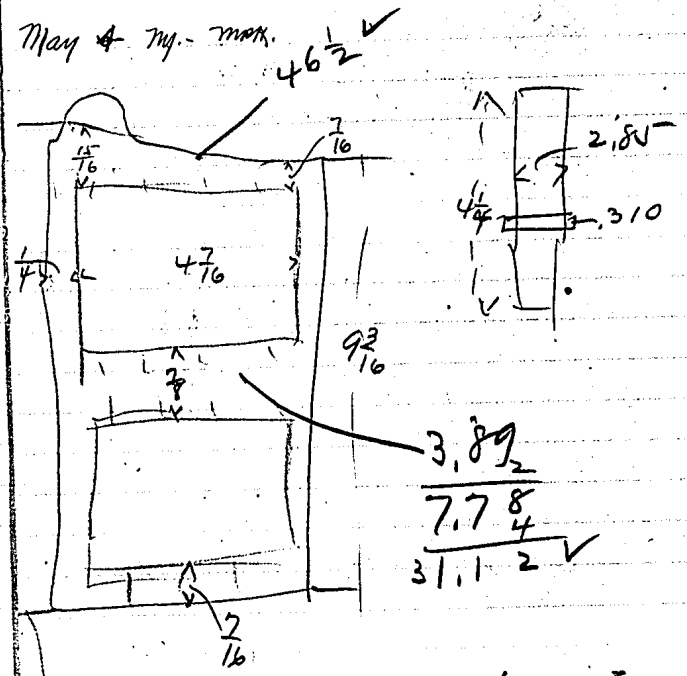
1	2 cells.	Reg. hydrate	.003 stk.	Std Perf.	(Sp. 9 + 10)
&	1 "	Bis. "	"	" "	
&	2 "	Reg "	.003 "	Small Perf	
&	1 "	Bis "	"	" "	
	2 "	Reg. "	.005 "	Std Perf	
	1 "	Bis "	"	" "	
	2 "	Reg "	"	Small "	
	1 "	Bis "	"	" "	
	1 "	Reg "	.003 "	Std "	Sq. ins.
	1 "	" "	.003 "	Small "	A.S. can - 1 prokers
	1 "	" "	new grits .003	large "	"

$t = 11\frac{5}{8} \times 4 = 44\frac{20}{8} = 46\frac{1}{2}$

Sum	45.6 0"
	502.5
	108.87
Solution +	611.37

Telephone Calls:

May 4 My. - max.

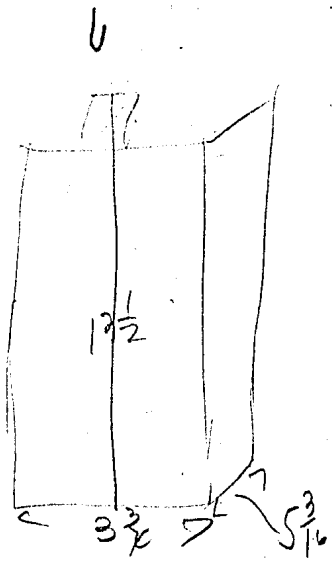


3.89 2
7.78 4
31.12

Total area plate =
27.22 4
108.88

a 4
all positions, tubes & pressure
a total metal area of
612 sq. in. / 30 amp =
20.4 sq. in per amp.
Inner cross strips and 3 x 1/2 in sol
= 20.4 : 1000 ma :: 3 : X =
150 m.a.

✓ 612 / 153



1-B+S mica cat # 72 ⌀ [illegible]
6"S locum mich.

~~An a⁴ cell has a surface area of grid & tube of Positive exposed to electrolyte =~~
~~104.24 sq in of all grid (pos)~~
~~458.14 " " " tubes (120)~~
~~Say 563 sq. in. in cell~~
~~When chg. @ 30 amp rate, is at rate of~~
~~53 m.a. per sq in. + @ 60 amp = 106 ma.~~
~~as anode.~~

~~an a⁴ cell has neg. grid & pocket surface~~
~~of 530 sq in.~~
~~when chg @ 30 amp rate = 56 m a per □".~~
~~60 " " 102 " " " "~~

Fluorine } — — — — {Pot. Fluoride
Bromine } Halogens. {Am. "
Iodine }
Chlorine —

Merck & Co. Inc.
Merck's Index